Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

A critical phase induced by interplay of spin-orbit coupling and Coulomb interaction EUN-GOOK MOON, CENKE XU, University of California, Santa Barbara, YONG BAEK KIM, University of Toronto, LEON BALENTS, Kavli Institute of Theoretical Physics — We study long range Coulomb interaction effect on the Luttinger Hamiltonian in three spatial dimensions, which describes strong spin orbit coupling intrinsically. The Hamiltonian has energy spectrum of inverted band gap semiconductors as in well-known HgTe; only one quadratic band touching point exists at the gamma point in Brillouin zone protected by the cubic and time reversal symmetries. Using controlled renormalization group techniques, we find that long-range Coulomb interaction converts the quadratic band touching state into a non-Fermi liquid (NFL) state, in some ways analogous to the Luttinger liquid state in one dimension. Consequently, all physical quantities become scale invariant and show deviations from non-interacting electrons' properties. Temperature and field dependence of various thermodynamic functions are obtained. Moreover, our ground state can be viewed as a parent state of topological insulators, magnetic metals, and Weyl semi-metals by breaking either cubic symmetry or time-reversal symmetry. The strong Coulomb interaction changes phase boundaries qualitatively and phase diagrams with the Coulomb interaction are provided. Applications to iridium-oxides materials are also discussed.

Eun-Gook Moon
University of California, Santa Barbara

Date submitted: 11 Dec 2012 Electronic form version 1.4